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Road and Weather Information Systems: A Concept and a Newsletter

Adverse weather conditions have a profound effect on the safety and efficiency of urban and rural travel throughout the United States. Whatever the weather—snow, ice, flooding, fog, dust, wind, hurricanes, or tornadoes—commercial vehicle operators, long distance travelers, transit operators, commuters, and others are affected. Decreased visibility, vehicle stability, and surface friction cause delays, incidents, and reduced pavement level of service. According to the U.S. Department of Transportation, approximately a third of all inter-urban road incidents occur during bad weather.

Beyond safety, inclement weather has important impacts on any region's economy. Most directly, transportation system operators must spend significant amounts of time and money keeping the roads running smoothly. As an example, $2.0+ billion are spent per year in the U.S. on snow and ice control, and $5.0 billion are spent each year repairing weather-related infrastructure damage. More indirect but also significant are the costs of lost productivity, lost mobility, delays, higher insurance rates, and liability suits. It has been estimated that a 1-day highway shutdown caused by snow costs a metropolitan area between $15 and $76 million in lost salaries, sales, and taxes.

These problems suggest that a comprehensive, real-time or predictive system of collecting and disseminating statewide road and weather information would be extremely useful, with the potential to save lives and money. Various state and federal agencies have begun to investigate the development of such comprehensive systems, called road and weather information systems (RWIS). (These RWIS are much broader in scope than the remote sensor roadway or runway information systems that many maintenance personnel are currently familiar with.)

Washington State experiences a variety of weather conditions, from the mountain passes to the coast, from the urban areas of Western Washington to the rural areas of Eastern Washington. To respond to needs for road and weather information across the

state, WSDOT has begun development of rWeather. This RWIS will include ways to collect comprehensive road data and weather condition forecasts. It will also package and tailor this information for use by WSDOT maintenance departments, as well as for advanced traveler information systems to aid the public.

This newsletter, sponsored jointly by the WSDOT rWeather project and by the Federal Highway Administration's Office of Weather Information and Winter Travel, is intended to inform members of the transportation and meteorology professions about current development of RWIS and the problems these systems address. Future editions of this newsletter will provide more details about WSDOT's rWeather and the progress of other programs around the country.

Three Current RWIS Programs

Foretell

FORETELL is a multi-state field operational test funded by the Federal Highway Administration's Rural Intelligent Transportation Systems program. FORETELL is combining advanced road data collection and weather prediction with other types of traveler information. The resulting RWIS will support seamless information sharing to benefit travelers, commercial vehicle operators, and transportation system managers.

The FORETELL concepts are being tested in fives states in the Mississippi Valley region, plus western Ontario. The program touches on the major metropolitan areas of Chicago, Milwaukee, Minneapolis/St. Paul, Kansas City, and St. Louis and reaches a total population of over 40 million. The Iowa Department of Transportation is the public sector lead, and Castle Rock Consultants is the private sector lead. Major partners in FORETELL include state governments, private entities, Canadian agencies, and the U. S. Department of Transportation.

rWeather

rWeather (**r**oad-Weather/"Our" weather—get it?) is the Washington State Department of Transportation's program for deploying a comprehensive, real-time and predictive system of collecting and disseminating statewide road and weather information.

In the first phase of the program, WSDOT will concentrate on collecting data and predicting conditions. By joining a consortium of weather data users, WSDOT will have access to data from over 350 remote weather sites and to the resources of the National Weather Service (NWS), Adanced Surface Observation Sites, and other

advances supported by the NWS's $4 billion upgrade program. Phase II of the program will be dedicated to data dissemination. Systems developed will provide information to WSDOT decision-makers and to the traveling public.

Aurora

Aurora is a long-term program of collaborative research, development, and deployment of advanced technologies for detailed road and weather monitoring and forecasting. The program, launched in 1996, brings together a number of U.S., Canadian, and European agencies, including the Minnesota, Iowa, New York, South Dakota, Virginia, and Wisconsin departments of transportation, the Federal Highway Administration, Ontario Ministry of Transportation, Ministere des Transports du Quebec, and Swedish National Road Administration.

Consortium members are working to implement advanced road and weather information systems that fully integrate state-of-the-art roadway and weather forecasting technologies with coordinated, multi-agency weather monitoring infrastructures. Areas of research include decision support systems, meso-scale modeling, micro-scale modeling, standards and architecture, information dissemination systems, and road condition monitoring.

Program	Start Date	Project Operational
FORETELL, Phase I	1997	30 months
rWeather	1998	24 months
Aurora	1996	Ongoing research

Interview with Paul Pisano

Perspectives on the Federal Weather and Winter Mobility Program

Paul Pisano is coordinator of the Federal Highway Administration's Weather and Winter Mobility Program. Below are his thoughts on road weather information systems (RWIS) at the national level and a discussion of the federal Weather and Winter Mobility program.

Improved weather information systems tailored to the surface transportation environment have proved to address both the direct and indirect impacts and costs of adverse weather. However, most of these systems were designed for only a specific application, such as maintenance purposes, have been poorly integrated with other traffic management and traveler information systems, and have been built independent of the larger

meteorological community. So although a wealth of weather information is available, this information is either poorly presented, or it is inadequate or inappropriate for the types of transportation decisions that require input.

Thus, the challenge is to develop integrated road-weather information systems (RWIS) that meet the demands of all users and operators, and to do so in a manner that is cost effective, building upon recent transportation and meteorological advancements.

Efforts to Date

The Federal Highway Administration (FHWA) continues to make Weather and Winter Mobility a priority in its transportation operations and rural intelligent transportation systems programs. Through combined program efforts, FHWA is working to identify user requirements for weather related applications and is beginning to address issues of information processing and dissemination. Specific research efforts have begun to develop a low-cost visibility sensor for the highway environment and remote sensors for detecting ice on pavements. FHWA has also been instrumental in the FORETELL field operational test to develop and evaluate an RWIS that integrates advanced road weather prediction with other types of traveler information. However, research and evaluation efforts have been limited, and more thorough field tests are needed.

Future efforts will focus on all technical aspects of the road transportation system, including weather data collection, processing, and dissemination, as well as the institutional challenges surrounding system implementation. These institutional challenges include coordination within state and local departments of transportation, as well as across the transportation and meteorological communities.

Progress for the Next Five Years

The Weather and Winter Mobility program intends to improve surface transportation under adverse weather conditions by developing more accurate, reliable, appropriate, and readily available RWIS, road-weather management practices, and winter roadway maintenance technologies. Such improvements will increase the mobility, safety, and productivity of the transportation system.

The program has three primary goals:

1) develop improved RWIS that meet the demands of **all** users and operators

2) develop road-weather management practices for all types of weather

3) develop improved maintenance technologies for winter mobility.

Over the next five years, the program will strive to achieve these goals by meeting five important objectives:

- At a national level, build consensus and continue to strengthen the relationship between meteorologists and transportation professionals, thus providing leadership for state efforts and creating a common vision for the overall program design
- Develop winter maintenance and traveler information decision support systems that are based on more comprehensive and accurate data collection, that furnish easily interpreted information, and that adequately combine all the types of information that highway system managers and users require to make informed decisions.
- Develop traffic operations practices and incident management procedures that respond to all types of weather.
- Develop advanced maintenance technologies that meet the needs of maintenance personnel.
- In coordination with current federal programs, develop outreach and course material for program delivery, training, and promotion.

Many projects will be required to reach these goals and objectives, including a series of research and field operational tests, and FHWA will be central to most of these, either as developer, coordinator, or promoter.

Program Accomplishments

The five-year results of the program should include several crucial accomplishments, including the following:

- the implementation of ten statewide, comprehensive RWIS in which coordination between the transportation and meteorological communities has been achieved
- the implementation of RWIS, designed and built within the context of the national ITS architecture, in at least five states
- the implementation of advanced RWIS products, such as state-of-the-art decision support systems, in at least three states.

Challenges

In accomplishing all this, the Weather and Winter Mobility program is faced wi

numerous challenges. First, although some progressive states have a clear commitment and desire to implement RWIS, most states lack the financial and institutional means to invest in RWIS. In addition, within public agencies, maintenance, construction, and traffic operations departments usually operate independently of each other. A lack of cooperation can undermine the ultimate goal of providing road-weather information to all who need it.

Although efforts to develop weather information systems for surface transportation are moving forward, they are complicated by the need for significant coordination between the transportation and meteorological professions. To date the two communities have had little direct interaction on a national level. Coordination is also necessary between the public and private members of the meteorological community, and limits of the National Weather Service charter and pressures on it to restrict its services will affect the success of RWIS.

Finally, delivery of road-weather information services is dependent upon the implementation of a wide range of technologies. However, implementation of the majority of these technologies is outside the scope of the Weather and Winter Mobility program.

The Ultimate Results

The challenges of effectively implementing RWIS nationwide may be minimized if organizations at both the state and federal levels share the same vision. Achieving the maximum benefit and desired output from this program will also require mutual interest and commitment—financial and institutional—from both the transportation and meteorological communities. Most important is that the meteorological community have a clear idea of surface transportation weather requirements in order to respond with the appropriate products and services. In addition, customers' expectations are high because of past successes, especially regarding winter maintenance. As the scope of the program expands, resources must keep up to maintain a respected level of service.

Even though so much weather information is available today, we have yet to fully embrace the link between the weather and roads. The pieces are there—a fully modernized National Weather Service and an intelligent transportation infrastructure; we just need to connect these two worlds so that we can provide the *right* road weather information to the *right* people at the *right* time. Doing so will allow us to be proactive when it comes to weather, rather than waiting until it hits and then suffering the consequences. The ultimate results will be saved lives, money, and time.

Interview with Clifford Mass

Weather Data and the Development of RWIS

Clifford F. Mass, professor of Atmospheric Sciences at the University of Washington, is working with the Washington State Department of Transportation to gather information from a variety of sources to supply the public, businesses, and government agencies with information on existing and forecast weather conditions that could affect transportation. The purpose of the project is to combine data from a number of sources across the state, including the National Weather Service, the Federal Aviation Administration, agricultural monitoring networks, air pollution sensing stations and even television station weather networks, with road-condition reports in a single database. All this information will then be made available at one location on the Internet.

In a recent interview, Professor Mass commented on current issues and challenges facing the developers of road and weather information systems:

Q.: How do you foresee weather information systems improving, and how will that affect transportation?

Mass: There has been a drastic increase in the amount of weather information that is available. It's been increasing exponentially. Between more observations of the surface, radars around the country, weather data from aircraft, and so on, there are a number of new sources of weather information. This is giving us a much more detailed picture of weather around Washington state and around the country.

In addition to all this information, the technology of weather prediction, especially high resolution computer weather prediction, has improved substantially. So we're starting to gain the ability to forecast the details of local weather. That is particularly important in places such as Washington state, where the mountains and water bodies produce all kinds of local weather effects, which are very important to be able to understand and predict.

We have computer models now that tell us where the precipitation is going to fall in the next 12 or 24 hours, so we have a very good idea of where the heavy snow will fall, how temperatures will be distributed and change, where the temperatures will be below freezing. This is all very important information that is not being used to the maximum benefit.

So between more and better observations and better predictions, we can provide the public and transportation personnel with a far more detailed and

accurate picture of the weather. That, I foresee, will have a revolutionary effect on how we take care of the roads and how people make decisions to use the roads.

Q.: Are the weather and transportation communities working effectively together?

Mass: I think that in the past there has been too much of a gap between the weather and transportation communities. I think that transportation professionals have not known enough about what is possible, regarding weather and weather systems, to do their job as well as they could. And I think the weather community may not have had an idea of the needs of transportation operational groups. So I think there's been a lack of communication. But our project and others are beginning to address that.

Q.: What kinds of challenges face the development of RWIS?

Mass: There are many technological issues to solve. What we're trying to do technologically is not easy. However, probably the biggest challenge we face is how to provide the information people need without overloading them. We have so much information that we have to find ways to present it without burying people. Obtaining the data and developing the forecasts, I know we can do. But finding a way of providing the results to people with a wide range of backgrounds and in a way that they find useful, that's a tremendous challenge.

Q.: How do you foresee that weather information will affect transportation?

Mass: Just to give a concrete example, I've changed the way I commute substantially because of high resolution weather data. Right now, here in my office, I get high resolution weather radar pictures that change every 6 minutes. I can see exactly where the rain is. I have always bicycled to work, but now I bicycle to work much more than I used to. In the past when I thought there might be showers I would drive, but now I bike almost every day because I can see exactly where it's raining, and I can time my trip so that when I get on my bicycle I can stay dry. Even on a rainy day there are places and times when the rain is lighter, so I can time it. So that's one example, but there are many examples of how highly detailed weather information will really help the driving public and transportation maintenance people.